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Mortality experience of electrical engineers

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We have followed up the mortality experience of a group of 1254 electrical engineers during 1930–79, all of whom graduated from the Royal Institute of Technology in Stockholm. The study population consisted of all the men who graduated from this university from 1930 to 1959 with a master of science degree in electrical engineering. These men have been exposed to a variety of laboratory and technical practices in school as well as later, focusing on telecommunication and power engineering. The mortality experience was recorded from the time of graduation to the end of 1979, giving a study period of up to five decades. Of the 1254 men, 11 were lost in follow up, mainly due to emigration. The rest could be certified as either alive or dead at the end of the study period. For those 108 who were dead, death certificates were collected from the local parishes or the National Cause of Death Registry.

The mortality in the study group was compared with the expected mortality calculated from age specific (five year groups) and calendar year specific mortality rates of the general Swedish male population for each diagnosis or group of diagnoses studied. The expected mortality for the earliest period (1930–50) was estimated from the rates for 1951–79, adjusted for trend. The standardised mortality ratios (SMR) were calculated for each diagnosis or class of diagnoses, together with a 95% confidence interval as described by Rothman and Boice.[1] The same was done for the group of 659 male architects who graduated from the same school during the same period to give a comparison with a group similar in background and social position. This group has been described in detail elsewhere.[2] Risks for electrical engineers were also compared directly with those for architects and relative risk (RR) estimates were calculated for some diagnoses.

When compared with the population at large the mortality of the engineers was found to be considerably lower than expected. As may be seen in the table, mortality in most major disease groups is significantly lower than expected. When compared directly with the group of architects the relative risk estimates were also lower for major groups of disease and differed significantly for the total mortality (RR = 0·7, 95% confidence limits 0·5–1·0), as well as for respiratory diseases.

Again, compared with the population at large, the mortality from cancer of electrical engineers was only half that expected and for specific cancer sites the observed number of deaths was always lower, or in one case similar, to the expected number. Only for malignant melanoma was there an excess risk, which is greater than threefold. Introducing the assumption of at least a 15 year latency time from the date of graduation to date of death, the risk of melanoma estimate became somewhat higher (SMR = 3·8, confidence limits 0·8–11·0). The three melanomas were on the trunk and the arm, and one was of unknown primary localisation. One of the three engineers had worked in the laboratory of a telecommunication company, whereas the other two worked mainly with power transmission. In the reference population of architects there were no cases of melanoma.

The low SMRs for the group of electrical engineers should be looked on as partly due to the "healthy worker effect" and partly as an effect of a less hazardous work environment and life style. Low mortality has been well documented for professional groups, although in this case the reduction seems particularly strong. This is the fourth cohort from the same university that we have studied in a similar way[2] and it is so far the healthiest. This is true also for cancer mortality.

Although there were only three cases of melanoma, in all likelihood this represents an excess risk. This is of particular interest in the light of a suggested risk of melanoma in blue collar workers in parts of the electronics and electrical manufacturing industry[3] (D Vågerö *et al*, unpublished data). It is also of interest in the light of two recent United States studies on the occurrence of malignant

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Observed and expected number of deaths for 1930–79 for Swedish male electrical engineers and architects

ICD (8th rev)	Electrical engineers				Architects			
	Obs	Exp	SMR	95% CI	Obs	Exp	SMR	95% CI
Infectious diseases (84–136)	1	4·8	0·2	0·0–1·2	2	2·4	0·8	0·1–3·0
All cancer (140–209)	24	50·4	0·5	0·3–0·7	16	26·4	0·6	0·3–1·0
Intestines (152–153)	3	3·6	0·8	0·2–2·5	3	1·9	1·6	0·3–4·6
Pancreas (157)	3	3·4	0·9	0·2–2·5	2	1·8	1·1	0·1–4·0
Lung (162)	4	9·0	0·4	0·1–1·1	5	4·7	1·1	0·3–2·5
Melanoma (172)	3	0·9	3·2	0·7–9·4	0	0·5	0	0–
Brain (191)	2	1·9	1·0	0·1–3·7	2	1·0	2·0	0·2–7·2
Leukaemia (204–207)	2	2·3	0·9	0·1–3·2	0	1·2	0	0–
Other cancer	7	30·6	0·2	0·1–0·5	4	15·4	0·3	0·1–0·7
Circulatory (390–458)	41	87·6	0·5	0·3–0·6	32	46·2	0·7	0·5–1·0
Respiratory (460–519)	1	7·3	0·1	0·0–0·8	4	3·9	1·0	0·3–2·6
Digestive (520–577)	5	12·1	0·4	0·1–1·0	5	6·3	0·8	0·3–1·8
Genitourinary (580–607)	3	4·2	0·7	0·1–2·1	2	2·2	0·9	0·1–3·3
Violent deaths (800–999)	18	38·0	0·5	0·3–0·7	16	19·5	0·8	0·5–1·3
All other	15	16·9	0·9	0·5–1·5	3	8·9	0·3	0·1–1·0
All causes	108	221·3	0·5	0·4–0·6	80	115·9	0·7	0·5–0·9

Obs = Observed.
Exp = Expected.
CI = Confidence intervals.

melanoma in the Lawrence Livermoore[3] and the Los Alamos National Laboratories.[4] Although the former reported a threefold excess risk, the latter found no such risk.

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